

PHYS 20323/60323: Fall 2020 - LaTeX Example

1. Consider a particle confined in a two-dimensional infinite square well

$$V(x,y) = \begin{cases} 0, & \text{if } 0 \leq x \leq a, 0 < y < a \\ \infty, & \text{otherwise} \end{cases}$$

The eigenfunctions have the form:

$$\psi(x,y) = \frac{2}{a} \sin \frac{(n\pi x)}{a} \sin \frac{(m\pi y)}{a}$$

with the corresponding energies being given by:

$$E_{nm} = (n^2 + m^2) \frac{\pi^2 \hbar^2}{2ma^2}$$

(a) (5 points) What are the levels of degeneracy of the five lowest energy values?

(b) (5 points) Consider a perturbation given by:

$$H' = a^2 V_0 \delta(x - \frac{a}{2}) \delta(y - \frac{a}{2})$$

Calculate the first order correction to the ground state energy

2. The following questions refer to stars in the Table below

Note: There may be multiple answers

Name	Mass	Luminosity	Lifetime	Temperature	Radius
Zeta	60. M_{sun}	$10^6 L_{sun}$	8.0×10^5 years		
Epsilon	6.0 M_{sun}	$10^3 L_{sun}$		20,000 K	
Delta	2.0 M_{sun}		5.0×10^8 years		2 R_{sun}
Beta	1.3 M_{sun}	$3.5 L_{sun}$			
Alpha	1.0 M_{sun}				1 R_{sun}
Gamma	0.7 M_{sun}		4.5×10^{10} years	5000 K	

(a) (4 points) Which of these stars will produce a planetary nebula at the end of their life.

(b) (4 points) Elements heavier than *Carbon* will be produced in which stars.